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REVENUE BOND FINANCING FOR
AIRPORT IMPROVEMENTS

by James C. Buckley

AIR TRANSPORT DIVISION

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AMERICAN SOCIETY OF CIVIL ENGINEERS

Founded November 5, 1852

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PAPERS

REVENUE BOND FINANCING FOR AIRPORT IMPROVEMENTS

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SYNOPSIS

The reluctance to provide adequate airport facilities with public funds frequently may be overcome through the use of airport revenue bonds. However, if such a method of financing is to be used, it must be thoroughly understood by the engineer so that he will design the facilities on the basis of the economic requirements imposed. Special factors to be considered in such a design are described in general.

INTRODUCTION

Before the end of World War II, the subject of this paper would have had little more than academic interest even for builders of airports. In 1953, however, there is no subject (with the possible exception of future federal appropriations for airport aid) which bears so directly on the volume and type of municipal airport improvements to be expected in the immediate future.

The explanation is simple. Municipalities have a pressing need for airport improvements that will cost hundreds of millions of dollars. Most of them, however, have an even more pressing need for streets, schools, sewers, libraries, hospitals, and other essential municipal facilities; and there is not enough margin within the limits of their general obligation debt to cover all the needs. Many of the needed airport improvements will not be made unless they can be financed outside the debt limit with some type of revenue obligation.

This situation is in large measure a result of World War II. Compressed into the five war years was a four-fold increase in air passenger traffic and increases in the size and weight of transport aircraft which otherwise might well have taken a decade—or even longer. However, there were almost no improvements at civil airports during the war years, except at those airports

used wholly or in part by the military.

At the beginning of World War II, the civil airport system was generally geared to the modest requirements of the DC-3 aircraft. This meant a required runway length at sea level of only 3,300 ft; a pavement strength adequate for aircraft with a gross weight of only 25,000 lbs; loading positions with a diameter of only 125 ft; and terminals geared only to the peak-hour loads of a 21-passenger aircraft serving an annual air travel market of only 3,500,000 people. Such relatively small and inexpensive facilities could usually be provided with proceeds from the sale of general obligation bonds without conflicting seriously with other municipal requirements.

At the close of World War II, however, essentially the same civil airport system was faced with the problem of meeting the greatly increased physical requirements imposed by a four-fold increase in air traffic and the introduction of the DC-4, the DC-6, and the Constellation aircraft. This meant a required runway length at sea level of 5,000 ft; a pavement strength adequate for aircraft with a gross weight of as much as 100,000 lb; loading positions with a diameter of as much as 160 ft; and terminals geared to the peak-hour loads of aircraft carrying as many as 58 passengers, these terminals serving an annual air-travel market of more than 12,000,000 people. It is not surprising, therefore, that terminal facilities at major air centers were overcrowded; that makeshift expansions were accomplished at many terminals; and that many certificated airline stops were without service entirely, or served only on a restricted basis, because of inadequacies in landing-area facilities.

Airport planning naturally became a common topic of conversation in many communities—planning not just for the needs of the immediate post-war period, but for the needs of Stratocruisers, the DC-6B's, and the Super-Constellations of the early 1950's, and for the needs of the even larger and heavier aircraft of the more distant future. With this planning came the first real appreciation of the astronomical increase in municipal investment which would be required to provide an adequate system of civil airports.

The City of New York (N. Y.) discovered that the development of the International Airport at Idlewild might require an ultimate investment of \$200,000,000—approximately ten times its investment in the much smaller La Guardia Airport—and it soon realized that the capital budget could not cover this large airport debt. This same problem faced the City of Newark (N. J.) when it was discovered that it would cost \$55,000,000 to redevelop Newark Airport—more than five times the original investment in the facility.

The City of Detroit (Mich.) learned that it would cost \$20,000,000 or more to replace the obsolete Detroit Municipal Airport with a new airport. Unable to provide such a facility, Detroit still uses Willow Run Airport, 32 miles away, for scheduled air service.

Philadelphia (Pa.) initiated a development program for its Southwest Airport which ultimately will require the investment of \$50,000,000, much of which still remains to be appropriated.

Cleveland (Ohio) submitted to the voters a proposition for issuing airport terminal bonds three times before securing approval, and this development was then threatened by the specter of insufficient funds as a result of sharp in-

creases in construction costs.

In large and small communities throughout the United States the situation has been the same. The problem has been alleviated to some extent by grants-in-aid from the United States government under the Federal Airport Act.²

² Federal Airport Act, Public Law 377, 79th Cong., 2nd Session, Chapter 251, approved May 13, 1946.

However, the dwindling appropriations under this act, and the increasing requirements of civil aviation, leave a growing balance of needed local investment in civil airports. Much of this will be financed, if at all, only on the security of the basic earning power of airport facilities. Here lies an opportunity as well as a challenging responsibility for the engineer.

The financing of airport improvements with revenue bonds presents an opportunity for the engineer to perform a real public service by helping a community to secure the needed airport improvements that otherwise might be long delayed or never built, and also to provide those improvements without burden to the taxpayers. Therefore, the revenue-bond financing of airport improvements presents an opportunity deserving earnest attention.

To grasp this opportunity, however, places a challenging responsibility on both the engineer and the architect because the ultimate success of revenue-bond projects at airports mainly depends on the engineer's understanding of the fundamental problems involved, and on his technical ability to develop solutions to those problems. It would be presumptuous for the writer to discuss the technical aspects of the engineering and architectural approach to problems involved in revenue-bond projects at airports. The writer can, however, suggest the fundamental points on which he feels the engineer must be informed in order to utilize his technical skills effectively.

Understanding of the Nature and Functions of an Airport.—An airport should not be considered merely a transportation terminal designed to accommodate aircraft and to process their passengers and cargo. With such a concept, consideration of airport revenue bonds would be pointless. The available revenues would fall far short of meeting the costs of providing, operating, and maintaining the necessary facilities, and there would be no margin to attract and protect revenue-bond purchasers.

Fortunately, the airport has many other functions which, with proper design and under proper development, can be more productive of revenues than can the strictly aeronautical activities. For example:

1. The airport is as important a terminal for ground transportation as it is for air transportation, since all the people and goods which move by air must also move to and from an airport by some mode of ground transportation. Adequate provision must therefore be made for access to highways, loading platforms for passengers, loading docks for cargo, space for taxicab holding lines, storage space for "for-hire" automobiles, and automobile parking areas.

That this ground transportation problem is no small task is indicated by the fact that at La Guardia Airport in 1951 approximately 400,000 taxicabs left the airport with passengers; more than 1,200,000 passengers rode in airport limousines; and more than \$300,000 was received from public automobile parking.

2. Of course, the airport is also a service station for aircraft. This involves facilities for (a) the repair and servicing of aircraft, (b) the overhaul of aircraft components and accessories, and (c) the inside and outside storage of aircraft. Cleveland, for example, has completed arrangements for the construction of a \$3,500,000 hangar at Cleveland Hopkins Airport, to be 1,375 ft long and to have 5 acres of concrete ramp.

3. The airport is also a service center for all passengers and visitors. The air passenger, the friends who meet him on arrival or accompany him at departure, and the casual visitors whom the aeronautical activities attract to the airport—all have a variety of consumption requirements that must be met. These requirements range from shoeshines to deluxe meals, but all are part of the airport complex which must be understood if the needs of its customers are to be met. This again is no small business as evidenced by the fact that the volume of restaurant and bar business at Stapleton Airfield in Denver, Colo., is now (1953) averaging more than \$1,250,000 per year.

4. The airport is also a recreational and entertainment center for the community. The restaurants, shops, and services necessarily provided at an airport as a service to air passengers and their friends, combined with the drawing power of the aeronautical activity at the airport, inevitably make modern airports a center of attraction for the entire community. This is strongly evidenced by the fact that an average of more than 1,000,000 people per year visited the observation gallery at La Guardia Airport between 1946 and 1952.

5. Also, the airport is a center for governmental activities concerned with aviation. Most airports of large or medium size have control towers operated by the Civil Aeronautics Administration (CAA), and a federally-operated weather station. In New York City, these two agencies have made their regional headquarters at Idlewild Airport, where they occupy a specially constructed \$4,000,000 building. Many state aviation commissions also make their headquarters at airports.

6. In addition, the airport is important as an industrial site. More and more industries are finding that the increasing importance of air transportation, both for people and goods, makes the land adjacent to the airport highly desirable for industrial use. At Friendship International Airport in Baltimore, Md., for example, an electronics corporation is completing (1952) a \$9,000,000 plant which is expected to employ 3,500 workers.

7. This complex of activities makes the airport also a major employment center in the community—actually an industry in its own right. At Love Field in Dallas, Tex., for example, a check in 1951 revealed that 2,850 persons were employed at the airport and an additional 800 persons with flying jobs were based at the airport. The total annual payroll for these two groups together, representing community income flowing from airport employment, was \$14,500,000.

8. Finally, these many activities of which the complex economic mechanism of a modern airport is composed, all depend on and support each other. The automobile parking lots are patronized by airline passengers, visitors, and employees. The use of the landing area depends as much on the availability of hangar and base facilities for various classes of aircraft and on the avail-

ability of good terminal facilities, as it does on the availability of good runways and taxiways. Industrial development at the airport means much to terminal-area revenues from employee patronage of terminal concessions.

This means that the design of facilities at airports must recognize and provide for the requirements of all types of airport activity if a sound basis is to be established for financing with revenue bonds.

Understanding of the Meaning of the Airport Revenue Bond.—Municipalities in the United States have from two to six billion dollars invested in airport facilities. The portion of this total resulting from the issuance of revenue bonds is infinitesimal.

The Port of New York Authority, through December 31, 1951, issued airport revenue bonds in the total face amount of \$72,400,000—but these bonds enjoyed the support of a reserve composed of revenues from bridges, tunnels, and other facilities, and were not marketed solely on the security of the revenues to be derived from the facilities to be established.

The Dade County Port Authority, at Miami, Fla., has issued airport revenue bonds to improve and extend the Miami International Airport, but these bonds were secured by a pledge of the revenues of the entire airport rather than by the revenues from the facilities constructed with the proceeds of the issue.

The only major airport revenue bond issue secured solely by the revenues of the facilities to be constructed with the proceeds of the bond issue was marketed in 1951 by the City and County of Denver to secure funds for the terminal development program at Stapleton Airfield. This issue totaled \$1,750,000 and was sold at an average effective interest rate of 3.3% to a syndicate headed by two firms from New York City.

A few small bond issues have been marketed under the name "revenue bonds," but these have required not only the pledge of the revenues from facilities other than those to be constructed with the proceeds of the bond issue (or even of the revenues of the entire airport), but also, in some cases, the mortgaging of the entire airport as additional security. Although this procedure has made possible the raising of capital without burden to the taxpayer, the pledging of airport revenues as a whole to support only one facility, or the mortgaging of the airport, creates a threat to flexibility in the future airport program (and even a threat to the continued existence of the airport as such) which most municipalities wish to avoid.

Therefore, the writer believes that in planning, the engineer should think of an airport revenue bond as an instrument which is usually to be secured only by the revenues of the facilities to be created with its proceeds. Sometimes, of course, it may be necessary to pledge additional revenues—up to the revenues of the entire airport—and even to mortgage the airport in order to accomplish essential airport financing. However, one should recognize that the revenue unit, which is the basis of the revenue bond financing, is completely flexible—it can be the airport as a whole, but it can also be an individual facility, a group of facilities, or even a part of one facility, as long as the revenues and related expenses can be properly segregated and designated.

Ability to Issue Airport Revenue Bonds.—Many airport officials have only a

rudimentary appreciation of the difference between a revenue bond and a general obligation bond. Many seem to feel that, when the debt limit is reached and the municipality can no longer issue general obligation bonds for airport purposes, it is a matter of simple financial technique to issue, forthwith, revenue bonds for needed airport improvements.

A consideration frequently forgotten, but which must always be understood, is that the revenue bond depends for its market on the assurance that net revenues from the facilities whose revenues are pledged will be sufficient to pay interest and amortization on the bonds as those payments become due. If such assurance is not reasonably evident from the data available on the facilities, it will be impossible to issue revenue bonds because no market will exist.

In this respect, the airport is no different from a private corporation offering its unsecured bonds in the market. Such bonds can be sold if there is reasonable assurance that the corporation has (a) a market for its product; (b) a plant that is neither too large nor too costly for its operations (one that will be economical to maintain and economical in production); and (c) a management and staff that will operate its plant and produce its product efficiently.

If the airport has a good market, a economical plant, and an efficient management, it can reasonably expect net revenues which will permit it to issue revenue bonds. It is the job of engineers to make certain that the airport has the kind of plant that will give it a sound basis for revenue bond financing.

Necessity of Evidence of Continuing Demand.—Bond investment is long-term investment. The buyer of revenue bonds must depend on net revenues to meet his claims for interest and bond repayment over long periods of time. He is not nearly so interested in whether the pledged facility will earn its debt service three times in a certain year as he is in receiving reasonable assurance that it will earn it perhaps one and one half times on an average over the entire life of his bond.

At an airport, such assurance depends on the continued demand for facilities—that is, the continued traffic potential at the airport. The term "traffic potential" is used because, although there are some exceptions, the bulk of the activity at an airport depends on the continued flow of air traffic through the airport. This is the life blood that keeps the fees and rentals flowing into the airport treasury.

There is nothing so comforting to the buyer of revenue bonds as to have the revenue bond facilities rented to tenants with prime credit ratings for the entire period of the bonds at rentals that will assure the payment of interest and bond amortization when due. This does not happen very often in the airport business, and a sound evaluation of traffic expectancy must be available both as an assurance to the buyer of revenue bonds and as a basis for the design and engineering of airport facilities.

Engineering for Low-Capital Cost.—No compromise is suggested of the quality of the efficient functional layout of facilities financed through revenue bonds. However, the engineer should be aware of what is needed, build within these restrictions, and avoid expensive features and ornamentation not required for the efficient functioning of the facility. The importance of this subject will be appreciated if it is remembered that, if one is trying to finance with twenty-five year, 4%-income bonds, for example, and have an indicated debt service coverage of 1.5, a 10% decrease in the construction cost will increase the debt service coverage to 1.66. This decrease will provide a more attractive bond in the market and may result in a lower effective interest cost.

To find out what construction is required, one must study traffic forecasts as well as activity forecasts, which show the types of activity that may reasonably be anticipated at the airport. Together, these will provide a basis for predicting plane movements, the type of traffic, and the airport population.

These are the raw materials on which one can base a study of requirements as to space and design, which will show the physical facilities required to accommodate reasonably the aeronautical and other activities in prospect. This is the design basis for a new airport or for a new facility on an existing airport. Of major importance in all airport construction—particularly in cases of facilities financed through revenue bonds—is designing and building slightly beyond near-term demand but avoiding the creation of civic monuments that have plagued airport development programs at cities throughout the United States.

The nature of an airport is such that the landing-area facilities will require much the same construction whether the demand will be for 100% of the capacity, or only 35%. A runway and related taxiways are needed regardless of how many plane movements are anticipated. However, little extra capacity is gained from three runways as compared with two runways or even one runway if the airport is primarily an airline airport used by large aircraft that can land considerably off the prevailing wind. In landing-area design, therefore, it may be possible to effect large savings in capital cost with little or no effect on capacity or revenue potential by reducing the number of runways to two or even one instead of the conventional three.

In terminal building work, economy in construction rests on a sound study of the requirements of space and design, and on a recognition of the functions of the various parts of a terminal building. Basically, the terminal is a working headquarters for the servicing of aircraft, the processing of air passengers and air cargo, and the vending of food, merchandise, and services to the public. The areas meriting costly treatment should be a relatively small percentage of the total area, and the income-producing areas must be a relatively high percentage of the total if the facility is to lend itself to revenue bond financing.

Designing for Economical Expansion.—Not only does the revenue bond buyer properly require assurance of a continued demand for the services of the airport facilities he finances—but also assurance that the facility he finances will not lose its market because it cannot be expanded economically to keep pace with growing demand. These facts are especially true of airports because this industry has barely tapped its full potential market. Naturally, this market rises and falls, which is why initial over-building is not advisable. It is equally true that the long-term trend is definitely upward and airports and airport facilities must be designed for economical expansion. This trend indicates the inadvisability of placing airports where expansion is limited by

railroad tracks, major highways, mountains, waterways, or other obstacles that cannot be overcome if more area is needed.

With respect to the runway layout, considerations as to future expansion require planning ahead for the possibility of longer runways and so placing them that such extensions will be possible without unreasonable cost for land acquisition or obstruction removal. It also means planning the bearing capacity of runways to accommodate larger and heavier aircraft later. In an airport that may reasonably require the capacity of parallel runways it is equally important to place the terminal area between the ultimate parallel runways, instead of having both runways on one side of the terminal. With parallel runways on either side of the terminal building, more than twice the capacity of a single runway will be realized when the parallel stage is reached. With both parallel runways on one side of the terminal building, less than twice the capacity of a single runway is obtained because of the necessity of moving aircraft to and from the far runway across the near runway, with consequent decrease in the capacity of the near runway to accept aircraft.

In planning the terminal building, the land reserved for terminal purposes must permit economical extension of the building and of the aircraft loading positions that serve it, as well as economical extension of ancillary facilities such as automobile parking areas, taxicab lines, circulation area for commercial vehicles, and similar features. This is equally true of hangar areas in which space should be reserved to meet the increasing needs of the aeronautical users of the airport.

Within the terminal building itself, the same type of problem exists. As airline business grows, the companies need more area for ticket counters, operational offices and passenger service, baggage and freight handling, and related activities. To build initially far in advance of demand is not feasible; but one can plan a facility so that the inevitable expansion of specific functions within the building can be made with a minimum of added expense. This is equally true of concession areas and public space in the terminal building, since they are all a function of the terminal population which increases with air traffic.

In summarizing the problem of expansion from the standpoint of the engineer and the architect, sound design and engineering for airport facilities typically require more professional work in relation to initial costs than do most construction projects because of the necessity of planning for almost inevitable expansion. This is a feature sometimes difficult for airport operators to appreciate, but it is essential that it be understood and that it be authorized in the case of revenue bond facilities.

Planning to Produce Maximum Revenues.—The initial factor contributing to the realization of adequate net revenues to support revenue bonds is a maximum development of gross revenues; and the production of maximum gross revenues can be realized only when that objective is kept constantly in mind—first, in the location of the airport itself, and then in the location and design of its facilities.

Much of the revenue of modern airports is received from the visitors from adjacent communities. That location having the greatest consumer market

readily available will produce the greatest revenue.

Also important are convenient access facilities (preferably on or adjacent to main highways) having direct service by public transportation vehicles. The airport should be within a reasonable cab fare of the city center.

The revenue potential of an airport also depends on space—to permit necessary expansion of the landing area in order to accommodate larger aircraft, to accommodate all the various types of activity that reasonably can be expected at the airport, and for expansion of individual facilities such as the terminal building and the hangers. Land at airports is seldom expensive in relation to the revenue that can be realized from its full development. Only by encouraging the provision of an adequate area initially can the planner be sure of having room to accommodate the balanced development essential to the production of maximum revenues.

The terminal area is the major revenue source at most modern airports. As a result, it stands to lose or gain most by the attention paid to revenue production at the design stage. Unless the terminal is designed to exploit fully the revenue potentially available, the chances of a feasible revenue bond program are almost nil.

The basic problem of designing air terminals for revenue production has vast ramifications. A few examples are presented.

At active terminals, an observation gallery is an important source of revenue—if there is no convenient free area from which to see the same activities. An observation gallery certainly should be provided—but free competition must not be permitted. The observation gallery will produce more revenue if it has convenient plumbing and electric connections to permit the installation of refreshment stands and vending machines.

Concessions provide considerable airport revenue—if they are exposed to all the people who use the terminal. Customers will not hunt for a place to spend their money. All the concession space reasonably required for the anticipated terminal population should be provided, but the flow of people should be centralized so that the people will be exposed to all the concessions in a concentrated area.

Automobile parking fees are sources of revenue at larger airports, provided parking spaces are adjacent to the terminal building and protected from equally desirable free competition. These ideas should be remembered when planning the areas adjacent to the terminal building. This fact applies also to taxicabs and car-rental agencies. They will produce revenue for the airport if allotted convenient storage area and service points so that they can develop business.

The submetering of electricity can be an important source of revenue at large airports—if it is possible under the rate schedules of the public utility and if the electrical distribution system is designed for it.

This simply means that revenue production at an airport is not a specialized activity which may be begun after the airport is built; to achieve the full potential at an airport, this phase must be provided for in the design stage.

Design for Economical Operation.—Another factor contributing to the realization of net revenues adequate to support revenue bonds is a minimum operat-

ing cost, which also depends largely on design, engineering, and construction materials. A few of the many operating factors that deserve attention will be described.

Snow removal with heavy equipment is relatively economical compared to snow removal with small equipment or by hand. Operating expense should be reduced at the design stage by eliminating or keeping to a minimum the sharp angles and constricted areas on the loading ramp where snow removal will require small equipment or hand work.

Every point at the airport that must be manned around the clock seven days a week will cost the airport the wages of four or five men. This includes guard stations, public-address control, pneumatic-tube control, telephone switchboards, and similar functions. By placing two or more of these activities at common or adjacent points, significant savings in the annual operating budget will be effected.

Public toilets are expensive to keep clean and are costly from the standpoint of the wages of attendants. The expense can be substantially reduced, and in large terminals eliminated, by transferring responsibility to a concessionaire—if the necessary facilities are concentrated in a few large installations rather than scattered throughout the public areas of a terminal.

Cleaning services comprise a large percentage of terminal operating costs, and vary widely depending on the materials used for walls and floors. Some materials are much better suited to the use of mechanical cleaning equipment than are others. A review of proposed construction materials with the airport custodial service or with a sanitation maintenance contractor can result in important savings.

It is necessary to meter utilities provided by the airport to its tenants. Usually of minor importance is the electricity supplied for illumination to miscellaneous tenants, and meters usually need not be provided. However, of great concern are the steam and hot water supplied to the restaurant concessionaire, and the electricity (for power and illumination) supplied to CAA, the United States Weather Bureau, the airlines, and the restaurant concessionaire. To the airport, these represent important costs which, when estimated, usually will be compromised on a basis favorable to the tenants and unfavorable to the airport. These utilities should be metered to protect the airport from loss.

Although these examples are not too significant individually, they indicate the responsibility of the engineer and the architect to contribute to the economical operation of the completed facility at the design stage.

Economical Use by Tenants.—Still another factor contributing to the realization of net revenues adequate to support revenue bonds is the provision of a facility that may be used economically by tenants. The more economical the tenants' operation, the more willing and more able they are to pay a proper rent or fee for the use of the facility.

The easiest way to discover which features and layout will be most economical for the tenants is to consult them—the concessionaires, ground transportation firms, government agencies, oil companies, airlines, and other major users of the airport. It may not be possible to supply all their require-

ments, but it will certainly be possible to offer them most of the features for which they are willing to pay.

Significant savings can be realized in tenants' operating costs by considering their problems at the design stage; for example—the distance, time, and cost of taxiing can be kept to a minimum if the terminal and hangar areas are located as close as possible to the runway ends. Also, the taxiing distance can be reduced and time and expenses saved by constructing frequent turnoffs from the runways to the taxiways. Of even greater benefit to airline tenants is the provision of adequate runway length and strength to permit tenants to use the field with their usual aircraft without restriction on payload.

Within the terminal area, both the airlines and the concessionaires have special operating problems which need recognition at the design stage if operating costs are to be kept to a minimum. The restaurant concessionaire, for example, will profit if food is prepared in a kitchen which has been designed to suit his particular type of operating needs. All concessionaires will benefit if convenient and accessible storage space is provided. Each airline will save if its operations space is convenient to the loading gates which it uses, and if the total space is concentrated into groupings which will avoid needless duplication of personnel.

In the hangar areas there are equally significant opportunities to achieve operating savings through proper design. A lighting installation with short-lived lamps can easily cost more in maintenance expenses plus capital costs, than a more expensive system requiring attention less frequently. The selection of a heating system should not only be based on its capital cost in relation to the area to be heated, but it should reflect other factors such as fuel savings (possible with added insulation) and possible savings from radiant heating in very high hangars.

Emphasizing the inclusion of the ideas of the tenants and users in the design of the airport facilities reflects the writer's conviction that the experience record of engineers is too limited to expect any large development of the market for airport revenue bonds without the cooperation of airport tenants and users, and also that their cooperation is increased if the facilities are made economical for them to use.

Independent Evaluation of the Engineer's Work.—This concept is important in the engineer's approach to financing airports through revenue bonds because the reaction of engineers to the "bankers' report" or "feasibility report" varies so widely. Perhaps this condition results partly from the fact that such reports vary rather widely also, with respect both to their scope and the extent of the detailed investigation.

In the development of airport revenue bonds, the type of security is so new and the scope of airport activities so complex that one can confidently expect to have the work evaluated independently as part of a feasibility report on any issue of consequence. Such an evaluation is necessary not only to assure the investor as to the soundness of the design, the engineering, and the cost estimates, but also to relate the engineer's work to other factors outside the scope of his responsibility.

It may aid understanding of the feasibility report and of the problems of

the individual who must prepare it if it is called, instead, an "audit of future prospects"—which it is indeed. As such, it must review not only the design, specifications, cost estimates, and construction schedules prepared by the engineers and architects, but also the following:

- a. The traffic, activity, and population forecasts on which that work is based;
- b. The reliability of the techniques used to convert those forecasts into requirements as to space and facilities;
- c. The validity of the proposed budget for operation and maintenance expenses;
- d. The reasonableness of the proposed structure and level of rates, and the resulting revenue forecasts;
- e. The reasonableness of the effective interest rate anticipated for the proposed bond issue; and
- f. The efficiency of existing management and the future prospects for efficient and economical administration of the airport.

In addition, the feasibility report must consider many contingent threats to the security of the proposed bond issue, including factors such as—

1. The threat of recapture by the federal government under existing agreements;
2. The obligation to provide free space and runway use to the federal government under existing agreements;
3. The effect of existing long-term leases with airlines and other tenants;
4. The danger of an assessment of real property taxes against airport property;
5. The possible reduction in airport capacity as the result of air space congestion;
6. The extent to which the aerial approaches to the airport may be endangered by uncontrolled construction that would impinge on flight paths; and
7. The danger of disastrous floods that might destroy the entire earning power of the facility.

Only when the work of the engineer and the architect has been evaluated and related to all these other factors does the bond buyer have an integrated picture of the future prospects of the facility he is being asked to finance solely on the security of those prospects. Therefore, he can hardly be blamed for feeling that "two heads are better than one" in protecting his interests.

CONCLUSION

A great quantity of needed airport construction will not be accomplished unless it is financed with revenue bonds. This fact provides an opportunity for engineers and architects to help their communities and to stimulate business if they can develop such projects which will pass the scrutiny of the buyer of revenue bonds. To do so, the engineer must recognize and understand some fundamental factors affecting the offering of airport revenue bonds such as have been described herein and he must apply them in his work on such issues.



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